FINKENBINDER

The Curve of Forgetting

Psychology

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THE CURVE OF FORGETTING

BY

ERWIN OLIVER FINKENBINDER

THESIS FOR THE DEGREE OF BACHELOR OF ARTS

IN

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IN THE

COLLEGE OF SCIENCE

OF THE

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THIS IS TO CERTIFY THAT THE THESIS PREPARED UNDER MY SUPERVISION BY

E. O. Finkenbinder

ENTITLED The Curve of Forgetting

IS APPROVED BY ME AS FULFILLING THIS PART OF THE REQUIREMENTS FOR THE

DEGREE OF Bachelor of Arts in General Science in the College of Science

J. W. Baird per S.S.C.

Instructor in Charge

APPROVED: Stephen S. Colvin

HEAD OF DEPARTMENT OF Psychology.

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THE CURVE OF FORGETTING.

The aim of the investigation reported in the following pages is to trace the course of the curve of forgetting as determined by a lapse of time. Every act of memory has of course to do with some remembered content; and within this content it is possible to distinguish two factors: 1). A memory image or group of such images of actual things perceived; and 2). Certain associative bonds which serve to connect one image with another and make of the whole a conscious complex. Both of these factors must be taken into account in any investigation of memory, because a complete sundering of the image factor and the association factor is impossible. Here we give our attention chiefly to the image. We hope to determine, as accurately as possible, what are the details of the nature of the curve. For purposes of isolating the image factor, we have chosen groups of nonsense syllables as our material. We may study the image phenomena in still purer and more isolated form by the use of evidence furnished by the introspection of our observers. Therefore, our results and the inferences which they justify, have to do with processes of memorizing and recalling in which the associative factor is reduced to a minimum and the image factor is raised to a maximum.

The first investigation for the determination of the rate of forgetting was undertaken by Ebbinghaus in 1879-80 and in 1883-84.[1]

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[1] Ebbinghaus, Privatdocenten der Philofophie an der Universität Berlin, 1879-80 and 1883-84.

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He attempted to discover the rate of forgetting nonsense material and also meaning material. His nonsense material consisted of meaningless syllables, while his meaning material was prose and poetry; e.g. Byron's Don Juan. Other psychologists were instigated to investigate with other sorts of materials. Thus Wolfe employed tones and made determinations for intervals up to 120 seconds.[2] Lewy employed visual extents, and determined how well they could be recognized through intervals up to 60 seconds.[3] Bigham chose words, letters, colors and numbers and worked with intervals of two, ten, and thirty seconds.[4] Baldwin and Shaw used simple geometrical figures and determined the degree of impairment of memory at the end of ten, twenty, and forty minutes.[5] In all of these investigations the work was much more limited than in the pioneer research of Ebbinghaus; but, so far as they go, they all agree in general with the Ebbinghaus curve of forgetting. Thus it appears that this curve applies to a great variety of memory material, - nonsense syllables, pitches of tone, visual lengths, geometrical areas, colors, numbers, letters, and significant words. Yet it is to be noted that these latter investigations deal with relatively brief intervals, - seconds and minutes. The determinations made by Ebbinghaus were for a longer period of time in each case, the longest being thirty days. Müller and Schumann tried to improve upon the

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[2] Philosophische Studien, III. 1886 534-71.

[3] Zeitschr. f. Psychologie u. s. w. VIII. 1893. p. 228.

[4] Psy. Rev. II. 1894. p. 29 ff.

[5] Ibid. 236 ff.

methods of Ebbinghaus by having an observer, Schumann, who was not at all connected with the operation of the presentation.[6] Ebbinghaus was both experimenter and observer and for this reason his results may not be entirely trustworthy, since his attention might have been easily distracted from his problem during the manipulation of the material; also he had made the syllables, had shuffled the cards and possibly did not avoid alliteration; and he avoided a fixed order in learning the syllables. He did not learn several syllables by their relative position to each other but changed the order each time he went through a series. Müller did not change the order of the syllables. He used a kymograph drum on which the syllables were presented in succession being exposed through a slit. His retentivity was slightly greater than that of Ebbinghaus.

More recently Meumann and Radossawljewitsch have plotted a curve of forgetting.[7] They saw the significance of the fact that in each of the previous experimental investigations the results were obtained from one observer only. Radossawljewitsch in 1903 and 1904 experimented with fourteen men and two women students ranging in age from twenty to forty years, and with six boys and five girls, seven to thirteen years of age, in the primary school. Though Radossawljewitsch used more observers than previous experimenters, he

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[6] Experimentelle Beiträge zur Untersuchung des Gedächtnisses. Von G. E. Müller und F. Schumann. Hamburg und Leipzig. Leop. Voss. 1893. (Sonderabdruck aus der Zeitschrift für Psychologie und Psychologie der Sinnesorgane. Band IV.)

[7] Das Fortschreiten des Vergessens mit der Zeit. Paul R. Radossawljewitsch Göttingen, W. F. Kaestner. 188.
Also 1 Band Das Behalten und Vergessen bei Kindern und Erwachsenen u. s. w. - von Dr. Paul R. Radossawljewitsch. 188.

did not consider the fatigue element which may occur in the latter part of the day. Ebbinghaus had distributed the hours of learning in such a manner that a part fell between the hours of 10-11 A. M., 11-12 A. M., 1-3 P. M., and 6-8 P. M. This prevented the fatigue effects from falling at the same point in the curve for each test. Radossawljewitsch, not taking this into consideration, found that his curve at the end of eight hours showed a greater amount forgotten than at the end of twenty-four hours or even two days. In the following table (taken from page 188 1 Band Das Behalten und Vergessen bei Kindern und Erwachsenen u. s. w. - von Dr. Paul R. Radossawljewitsch,) the results of Ebbinghaus are compared with his own for both meaningless and meaningful material: -

Table.

Periods or intervals for determination.	Results of Radossawljewitsch.				Results of Ebbinghaus.	
	For grown ups.		For children.		For himself.	
	Meaningless Material.	Meaning Material.	Meaningless Material.	Meaning Material.	Meaningless Material.	Meaning Material.
	The quantity forgotten, in per cents.					
1. 5 Min.	2.5	0.0	8.8	1.7	...	...
2. 20 "	11.4	3.9	14.6	5.5	41.8	...
3. 60 "	29.3	21.7	22.7	17.9	55.8	...
4. 480 "	52.6	41.9	37.0	35.3	64.2	...
5. 1 Day	31.1	20.3	28.3	20.7	66.3	41.8
6. 2 Days	39.1	33.2	31.9	28.2	72.2	...
7. 3 "	...	43.5	...	...	...	...
8. 4 "	...	45.5	...	...	...	...
9. 5 "	...	43.5	...	...	...	...
10. 6 "	50.7	57.6	42.4	40.7	74.6	...
11. 7 "	...	50.0	...	...	...	...
12. 14 "	59.0	70.0	46.1	45.3	...	...
13. 21 "	62.2	52.4	49.5	55.5	...	...
14. 30 "	79.8	76.1	66.2	71.9	78.9	...
15. 60 "	...	...	94.3	85.4	...	...
16. 120 "	97.2	...	...	...	...	...

With the methods and results of formed experimenters in mind, under the direction of Dr. J. W. Baird, Alida C. Bowler and the writer took up the present problem in the laboratory of the University of Illinois. A summary of the points of difference between former investigations and our own is as follows:

1. The observers were fourteen in number. Ebbinghaus was alone.

2. An experimenter presented the material, thus attempting to avoid any distraction to the observer which naturally arises when he presents his own material.

3. The materials were of nonsense syllables and were built in series which were carefully prepared with a view to avoiding alliteration and various associative bonds between parts.

4. The observers were permitted to follow their own ways of learning, except they were cautioned not to group syllables nor to look for associations. (Radossawljewitsch used rhythm in presentation. Ebbinghaus avoided learning by position, for each time he read through the syllables, he read them in a different order.)

5. A number of practice series were first given to familiarize the observers with their part of the work.

6. Between successive determinations a time of eight hours or more was allowed to pass so as to avoid confusion of the older trial with the new trial. (Radossawljewitsch gave three new series each day.)

7. Fourteen different intervals between learning and relearning were employed. In order to neutralize the results of practice, which may increase as the experiment progresses, these intervals were distributed in such a way that no one type of interval was

bunched at any point in the progress of the experiment. This precaution Radossawljewitsch failed entirely to observe.

8. To prevent the fatigue element from falling at one place in the curve, the following times of presentation were chosen:- 8 A. M., 11 A. M., 2 P. M., 5 P. M., 8 P. M., and, for a few observers, 11 P. M. so that the eight hour interval, a point of especial interest, could be more thoroughly investigated.

9. Introspections were given by the observer so that there could be intelligent assurance of the control in each trial.

As stated above, the specific effort of this investigation, has been to find the curve of forgetting for the individuals and the average curve for all observers, using non-associative materials as far as may be, and allowing the observers to use their habitual ways of learning. The methods and materials are described in greater detail as follows:

A. All possible combinations of three letters containing one vowel, that being the middle letter, were made. Beginning with bab, bac, bad, baf, bag, etc. and beb, bec, bed, bef, beg, beh, etc. using every vowel, a, e, i, o, u, in turn and every consonant in every possible combination, there were 2,205 syllables produced. All familiar ones and those suggesting words or meaning were omitted. For example, of the above given, only beh was used. The syllables suggestive to Miss Bowler were struck out by her. Then the writer cancelled many still remaining which were suggestive to him. Dr. Baird then reviewed the remaining syllables and made still further exclusions. After choosing a few more than one thousand nonsense syllables these were put together into series, twelve syllables in each, and in such order that no two successive syllables

contained the same vowel. The same method of procedure was followed for the consonants. The same vowel or consonant does not appear in the second following syllable, lest it encourage association. Each of three vowels appear two times in a series, and two vowels three times. No consonant was used more than twice as an initial letter, and if used twice occurs only once as closing a syllable. No consonant appears twice in the same syllable, according to the plan. No syllable follows another which resembles it in respect to shape or sound or is near it in the alphabet. 'X' should not follow 'Z' for they may be pronounced alike, 'N' should not follow or appear near 'M', 'M' should not appear near 'W', 'P' should not be near 'B', 'A' should not fall with 'V' for they may bring association by likeness of shape; and 'B', 'C', 'D', 'F', or 'X' and 'Y' should not be used close together for they are known by their place in the alphabet, - and a meaning is attached to them. Thus eighty series were arranged of which the following are examples: Series No. 71:- QIJ, XAC, SOH, VIG, HOQ, MUP, GOZ, NEM, YOG, TIQ, PUV, ZAM; Series No. 73:- WUF, JAQ, GOK, NIW, VER, XAD, QOS, LEV, YUH, KOJ, ZID, QEC; Series No. 75:- MAZ, VEQ, BIW, QOP, NEX, FIY, WOH, JIX, NAF, XUS, NEV, ZOG.

B. The syllables were made of plain black capital letters, one and one-fourth inches in height and one and one-eighth inches in width. Each line in the letter was made three-eighths of an inch wide. They were placed upon white cards measuring five inches wide by seven inches long. Each series of cards was fastened at the lower edge in the form of a book, with front cover, for convenience of exposure.

C. The syllables were presented by holding the book upon its lower edge and turning down the stiff leaves. During the practice preliminery to the work upon the problem, variations in the presentation time were made and it was found that the optimal time of presentation was two seconds for each syllable. All experiments were performed in a quiet room.

D. The observers were instructed to note their method of learning the syllables, in so far as this did not interrupt nor interfere with the process. They were asked to learn the syllables just above the threshold of reproduction - so as to recall each before it came into view. Then they were to note the presence or absence of associations and to record this fact. Also they were to tell how they learned, giving full introspection but without writing the syllables learned or bringing them in mind. The observers were instructed to give no farther thought to the syllables until the desired interval of time had elapsed, when there was a brief recall to see what they could easily reproduce. They then relearned in the same way as before just to the point of bringing to mind each syllable before it came into view. A record of the time of relearning and the number of repetitions necessary was made by the experimenter.

E. The observers were:-

1. Sara C. Fisher, graduate student in psychology.
2. Alida C. Bowler, senior L. and A., Languages.
3. Sophie ~~Sarah~~ Rogers, junior, Languages.
4. Amy Overland, freshman L. and A.
5. H. F. Swits, senior L. and A., psychology.
6. O. L. Herndon, senior, business course.

7. C. E. Burgener, senior, psychology.
8. E. B. Pletcher, junior L. and A.
9. E. O. Finkenbinder, senior Science, psychology.
10. J. Sinclair, junior L. and A.
11. L. J. Pletcher, freshman Science.
12. J. E. Wiley, special Agriculture.
13. R. R. Finkenbinder, special Agriculture.
14. L. Seyster, Academy.

As stated before each observer has his own way of learning. The learning type which predominates in each individual will later be given with the tabulated results. Observers E. B. Pletcher, J. E. Wiley, and H. F. Swits gaze intently at the syllables while learning them. They state that they do not repeat the syllables, just merely"look at them." At times however, they notice they think them over and over, while looking. E. B. Pletcher prefers to take just a glance at the syllable and then turn away, picturing it in space and retaining it, if possible, as a visual image. He recalls by the use of the visual image. At times he knows how the form of the syllable appears but is not sure whether the letter is 'H' or 'K', or even 'B' though he knows that it is not 'C' or 'Q'. He remembers a "full" syllable opposed to a "thin" one - as MUB and YIL. Occasionally when he tries to learn a hard syllable he thinks it over and over - "Reproduces it in the mind".

The introspections show that Mr. Swits articulates the syllable, not audibly, and usually not with motion perceptible to the experimenter. He has at times moved the lips while learning. His thought and energy are spent in learning the syllable before him and, after looking at each syllable a few times, he takes a small

portion of the two seconds, in which the syllable is before him, in trying to bring to mind the succeeding syllable before it comes into view. Some syllables force their way upon his memory in visual images and he images just how the next one looks before it appears. As the test progresses he spends more and more of his time in this manner, and is soon able to image them all before they come into view.

Mr. Wiley says, "They just come", and, "I just look at them", yet he has at time repeated them, moving his lips.

Mr. L. J. Pletcher and Mr. R. R. Finkenbinder prefer to repeat the syllables in a whisper or aloud. They say for instance, QIJ, QIJ, QIJ, XAC, XAC, QIJ, XAC, and when the next one appears, while it is before them they say QIJ, QIJ, XAC, SOH, SOH, SOH, then VIG, VIG, VIG, SOH, VIG, - HOQ, HOQ, HOQ, HOQ, etc. in varying time and rhythm while the series is being presented three or four times. Then VIG is known to be there when the fifth presentation is begun. Sometimes the syllable is brought forward in the list from fourth to second, or from ninth to fifth. These known syllables make the series more easy, and they make stopping or resting places. As they come "popping up", sometimes as many as four newly predicted appear in succession. During this stage of learning the observers say the attention is mostly given to searching for or predicting the syllables in the series. They "try on", i.e. articulate, 'TOG' or simply '?OG' and find it is 'YOG'. They say it a time or two and go on predicting. They frequently predict too soon and thus seem to be set back. The above named method is used by the writer but in a modified form. He does not move the lips and does not think of the ease or difficulty if pronouncing, but gets the high

sound of YIK, NIQ, TIJ, the round sound of YOG, BOQ, and a peculiar empty sound for PUV, GUB; but for MUP the M is a visual image. The H is usually a visual image in recall and thus "sticks" in mind sooner.

Alida C. Bowler employs repetition or vocalizing of the syllable, and vocalizing appears to be almost as prominent in each of the other women observers. Though it is recorded that Miss Rogers most often repeats the series before her, the visual image often plays a very strong part. In some cases she reports she "just looks at the syllables" and learns them.

Miss Fisher has particularly associative methods of learning. Many odd associations are formed with syllables which seem to other observers to have no connection whatever; as HOQ = honesty, YOG becomes JOG, a word, LOZ = LAWS, and PUV = pulverize. As many as six or eight associations are recorded in her introspections on learning and recall of a single series. Her associations seem effective to her as a means of recall, and in relearning they undoubtedly facilitate the coming of the syllables again to consciousness.

The observers then seem to fall into the following types: the quiet visualizer, the noisy vocalizer, the quiet vocalizer and visualizer, and the verbal associater. The images which each employ are most prominently of one kind, though no observer uses one sort of image exclusively. Below is inserted a copy of a typical original sheet showing the length of time for learning and for relearning; also showing the introspections given by the observer both at first learning and at relearning. The introspections show that the first observer mentioned is predominantly visual. He was un-

able to recall without considerable hesitation.

E. B. Pletcher.

Series No. 41. 8 P. M. Jan. 27.

Learning - Ten presentations of each syllable.

Relearning - after seventy-two hours - Six presentations.

Time of exposure - two seconds for each syllable.

Introspection.

"The syllables were not learned by grouping, but were learned individually; the first stuck on the first time through. Then the next one was associated with it, and each to the one preceding. The last two or three came together after about five times. I learned them by seeing and saying each one before it fell."

Introspection at relearning.

"Could recall none of the syllables at first. The audible mention of one or two of them did not even seem familiar. One syllable from another group, 'WES', came to mind. No especial plan of learning was used, the syllables seemed to stick just by looking them over."

E. B. P.

Another sheet of data, a record of the observer R. R. Finkenbinder, is also presented.

R. R. Finkenbinder.

Series No. 48. 11 A. M., Feb. 6.

Learning - Nine presentations of each syllable.

Relearning - after eight hours - Four presentations of each syllable.

Time of exposure - Two seconds for each syllable.

Introspection.

"They seemed to come easy this time. I had no associations. The first six came first, or I learned them up to GIK which seemed to be a stopping place and from there on to the end I had the rest without any one which I made as a place to stop. I just started in and would keep repeating the first ones till I got up to GIK and from there on I did likewise with the rest."

R. R. F.

Introspection at recall.

"I think of them as capitals as they were on the page in the series."

Relearning.

"I had no associations the first time but this time the first one, VES, made me think 'vest'. I just added the 't'. I did not group but ran up through them till GIK and from there to the end. They came real easy as I almost knew them before but I could not quite think of them to write them down. It seemed as if I knew the first ones better than I did the last ones."

R. R. F.

Recall.	Corrected.	Recall.	Corrected.
VOS	VES	GEK	GIK
CIX	CIX	...	SAF
...	YAL	...	QUD
FUB	FUB	...	POJ
S-X	JER	...	HEP
...	TOZ	QUS	WAH

The introspections of this observer show that he is visual or

could raise visual images of the syllables. Two of the syllables given in recall show that his images of them were impaired during the interval of time, eight hours, elapsing. He seems not to be troubled giving in script what he saw in capital print.

GEK is given for GIK and though he says he thinks of them as "capitals as they were on the page in the series", yet it seems that he has given a more nearly similar sounding or silently articulated syllable than one of similar appearance. VOS occurs in his recall while VES is the correct syllable. Whatever image or images he has used in learning have been impaired. In another series (No. 16) given below, both CEV and SEV were given for the second syllable. The auditory images for S and for C are more likely to be confused than visual images of these same letters. The observer states that the syllables come in order and he can easily discern that the sound of one syllable brings up another. He recalls DAS but the correct syllable is DAQ, and it is likely that the sound image of DA was the means for the recall of DAS. He gave Q wrongly as the end letter of the preceding syllable, and his common sense would not allow the Q to occur in DAQ also. The question arises was it the sound of the Q which forced itself in the WIB syllable or the picture of Q? He says he remembered "by the sound". In the last syllable as recalled he has perhaps remembered the sound of EQ but not the G as the beginning letter instead of the right letter, S. Since the observer repeats the syllables, whispering them, or speaking aloud, it seems likely that he recalls the syllables "by the sound". So the writer classif ies him as one who uses predominantly the auditory image in recall, or possibly, though he does not discover it, the auditory and motor images.

This belief is strengthened by the fact that the observer learns the series by articulation and his lips were seen to form the word in recall as if pronouncing the syllable to see if it were the correct one.

R. R. Finkenbinder.

Series No. 16: 11 A. M. Feb. 20.

Learning - Ten presentations of each syllable.

Relearning - after one hour - Three presentations of each syllable.

Time of exposure - Two seconds for each syllable.

Introspection.

"Found a stopping place at GOS. It was Dean Goss. It made an easy story. I then found that the rest came easy and I found no particular associations or groupings. I pronounced them as usual and learned by predicting what would fall before it came. I have it just to the point that I can predict each before it falls in view. But I don't remember them now."

Dictated to E. O. Finkenbinder, experimenter.

Introspection at recall.

"I remembered one by association and RAB by association. I just remembered by the sound. I thought I knew the first six better than the last but I could not call them to mind as well as the last ones; from MUN to the end they seemed to come in order. I remembered the first two the plainest but forgot if it was SEV or CEV and the third I know there is an J in but forgot, but think there is O and D in too."

Recall.	Corrected.	Recall.	Corrected.
RAB	RAB	GOS	GOS
SEV or CEV	CEV	...	KEH
JOD or DOJ	JOD	PUY	PUY
WIQ	WIB	FIJ	FIJ
DAS	DAQ	XOB	XOB
MUN	MUN	GEQ	SEQ

It is seen that for each observer a particular method is used in learning, and that the imagory used in recall agrees with the images most strongly drilled in during learning. All observers show, at times, signs of visual imagery on recalling. Some observers use one kind of imagery for the most part but fall back upon others for aid in difficulty; while others seem to be more firmly bound to one type. These differences do not appear to be responsible for much variation among the individual curves, unless it be in the case of the observer who formed meaning associations. But here the effect of the image cannot be so clearly examined for it is obscured by the association. Most of the observers note that few associations with familiar or meaning material have been formed. The complete numerical results are given below in tabulated form. Few sheets of data have been excluded on the basis of the introspection in the case of poor learning or relearning caused by some disturbing factor. For a few periods in which the results show very great variations, repetitions of the determinations have been made.

No attempt is made to show the quantitative difference in the relearning of series wherein associations are made with meaningful

material. Radossawljewitsch has shown that there is an average difference of eight per cent in the memory of nonsense and meaningful material. Only a few meaningful associations were brought to the notice of the observer, and the influence of a few associations is slight. The methods for measuring the retentivity are not sufficiently fine to admit of calculation of single per cents. Therefore when the observer uses more than three or four associations the results are not counted, but if there are less, the difference is negligible.

The tables below have been made from data gathered by the above methods of discrimination. The percent is the ratio of the time used in relearning to the time used in first learning. When the observer required twelve repetitions to the series - (two seconds for each syllable - in all 288 seconds) - in the first learning of a series and four repetitions or relearning, the ratio of the time for relearning to the time for first learning is 33.3%, which is approximately the per cent forgotten. If he had required twelve repetitions for relearning the per cent forgotten would seem to be 100%, approximately. If six repetitions had been necessary in relearning, the percentage forgotten would be about 50%. This method was used for computation by earlier experimenters and is well understood; thus at this point no further discussion of it seems necessary.

Complete results are given below so that the experiment may be taken up by any experimenter and carried on for greater accumulation of data and thus greater accuracy in the final result may be obtained.

L. J. Pletcher. Auditory-visual type.

Times of presentation.

	8 A.M.		11 A.M.		2 P.M.		5 P.M.		8 P.M.			
Interval.	Presentations at learning; at relearning.	Forgotten.	Presentations at learning; at relearning.	Forgotten.	Presentations at learning; at relearning.	Forgotten.	Presentations at learning; at relearning.	Forgotten.	Presentations at learning; at relearning.	Forgotten.	Average percentage forgotten.	Probable error.
1/2	12-3	25%	12-4	33%	8-2	25%	11-3	27%	13-3	23%	26.0%	1.0%
1	9-3	33%	11-4	36%	9-3	33%	12-4	33%			33.7%	0.7%
2	13-4	30%	11-4	36%	9-2	22%	10-4	40%	9-4	44%	34.4%	3.0%
4	14-4	29%	14-6	43%	13-6	46%	14-6	43%	.. .	..	40.2%	2.6%
8	9-4	44%	11-4	36%	10-4	40%	9-3	33%*	.. .	..	38.2%	1.2%
12	13-5	39%	.. .	..	.. .	..	.. .	..	10-4	40%	39.5%	
16	.. .	..	.. .	..	.. .	..	12-5	41%	8-3	37%	39.0%	
24	11-5	45%	12-6	50%	10-4	40%	16-4	31%	8-3	37%	42.6%	2.8%
36	13-6	46%	.. .	..	.. .	..	13-7	54%*	10-4	40%	46.3%	2.5%
48	10-5	50%	11-5	45%	12-5	42%	14-8	57%	17-11	65%	51.8%	3.1%
72	13-6	46%	5-4	80%	7-5	71%	12-6	50%	9-6	66%	66.6%	4.0%

* Recall could not have been taken if presentation had been at the regular hour; presentation was given at eleven P. M.

R. R. Finkenbinder. Auditory type.

Times of presentation.

	8 A.M.		11 A.M.		2 P.M.		5 P.M.		8 P.M.			
Interval.	Presentations at learning; at relearning.	Forgotten.	Presentations at learning; at relearning.	Forgotten.	Presentations at learning; at relearning.	Forgotten.	Presentations at learning; at relearning.	Forgotten.	Presentations at learning; at relearning.	Forgotten.	Average percentage forgotten.	Probable error.
1/2	8-2	25%	15-6	40%	8-2	25%	13-5	38%	11-3	27%	31.1%	2.1%
1	12-4	30%	10-3	30%	9-3	33%	13-4	30%	11-4	36%	32.1%	1.0%
2	9-3	33%	9-4	44%	10-4	40%	13-5	37%	9-3	33%	39.0%	1.4%
4	12-5	41%	12-5	41%	12-5	41%	11-4	36%	.. .	..	39.7%	0.7%
8	12-5	41%	9-4	44%	9-4	44%	9-3	33%*	10-4	40%*	39.6%	1.5%
12	8-3	37%	.. .	..	13-5	38%*	.. .	..	8-4	50%	41.6%	2.5%
16	.. .	..	.. .	..	.. .	..	12-4	33%	9-4	44%	38.5%	2.5%
24	13-8	60%	11-5	45%	11-4	35%	16-7	44%	10-5	50%	47.0%	2.4%
36	12-5	42%	.. .	..	.. .	..	.. .	..	10-5	50%	46.0%	2.5%
48	12-6	50%	11-8	72%	7-4	55%	9-5	55%	12-7	58%	60.0%	2.4%
72	12-6	50%	12-6	50%	13-9	70%	10-5	50%	11-7	64%	56.8%	2.7%

* Recall could not have been taken if presentation had been at the regular hour; presentation was given at eleven P. M.

Miss ~~Sarah~~ Sophie Rogers. Auditory-motor.

Times of Presentation.

	8 A.M.		11 A.M.		2 P.M.		5 P.M.		8 P.M.			
Interval.	Presentations at learning; at relearning.	Forgotten.	Presentations at learning; at relearning.	Forgotten.	Presentations at learning; at relearning.	Forgotten.	Presentations at learning; at relearning.	Forgotten.	Presentations at learning; at relearning.	Forgotten.	Average percentage forgotten.	Probable error.
1/2	10-2	20%	11-2	18%	9-2	22%	10-3	30%	9-1	11%	20.2%	2.0%
1	10-3	30%	9-3	33%	8-1	12%	10-3	30%	10-3	30%	27.0%	2.6%
2	8-3	37%	11-3	27%	9-3	33%	8-2	25%	11-3	27%	29.8%	1.6%
4	10-5	50%	7-3	42%	12-4	33%	7-2	28%	.. .	..	38.0%	2.6%
8	10-4	40%			10-4	40%	.. .	..	.. .	..	40.0%	
12	10-4	40%	10-5	50%	.. .	..	.. .	..	10-3	30%	40.0%	
16	.. .	...	.. .	..	.. .	..	10-4	40%	8-3	38%	39.0%	
24	10-4	40%	10-4	40%	8-3	38%	9-4	44%	8-4	50%	42.4%	1.3%
36	8-4	50%	.. .	..	.. .	..	.. .	..	12-6	50%	50.0%	
48	9-5	55%	12-6	50%	10-5	50%	11-6	55%	10-4	40%	50.0%	
72	9-4	44%	8-4	50%	10-5	50%	10-7	70%	8-4	50%	52.8%	3.2%

J. E. Wiley. Visual type.

Times of presentation.

	8 A.M.		11 A.M.		2 P.M.		5 P.M.		8 P.M.		
Interval.	Presentations at learning; at relearning.	Forgotten.	Presentations at learning; at relearning.	Forgotten.	Presentations at learning; at relearning.	Forgotten.	Presentations at learning; at relearning.	Forgotten.	Presentations at learning; at relearning.	Forgotten.	Average percentage forgotten.
1/2	8-1	13%	8-2	25%	6-2	33%	12-3	25%	18-4	20%	23.2%
1	7-2	29%	8-2	25%	9-3	33%	9-2	22%	7-1	14%	24.6%
2	8-3	37%	9-2	22%	7-2	28%	7-2	28%	11-3	27%	29.2%
4	10-4	40%	7-2	28%	7-3	42%	10-3	30%	.. .	..	25.2%
8	12-4	33%	9-4	44%	7-2	28%	.. .	..	.. .	..	35.3%
12	8-4	50%	.. .	..	.. .	..	17-3	20%	7-3	42%	27.3%
16	.. .	..	.. .	..	.. .	..	7-3	42%	12-5	42%	42.0%
24	7-3	42%	10-4	40%	6-3	50%	7-2	28%	10-4	40%	45.8%
36	7-3	42%	.. .	..	.. .	..	.. .	..	12-4	33%	58.0%
48	8-4	50%	8-3	37%	5-2	40%	9-4	44%	10-6	60%	46.0%
72	7-3	43%	7-4	57%	7-3	42%	9-4	44%	10-6	60%	49.1%

E. B. Pletcher. Visual type.

Times of presentation.

	8 A.M.		11 A.M.		2 P.M.		5 P.M.		8 P.M.			
Interval.	Presentations at learning; at relearning.	Forgotten.	Presentations at learning; at relearning.	Forgotten.	Presentations at learning; at relearning.	Forgotten.	Presentations at learning; at relearning.	Forgotten.	Presentations at learning; at relearning.	Forgotten.	Average percentage forgotten.	Probable error.
1/2	11-3	27%	13-1	8%	9-4	44%	10-1	10%	10-2	20%	21.8%	3.9%
1	8-2	25%	9-3	33%	9-1	11%	14-7	50%	11-4	36%	31.0%	5.4%
2	11-3	27%	10-4	40%	6-2	33%	6-2	33%	9-2	22%	31.0%	1.9%
4	10-4	40%	7-2	30%	8-3	37%	11-4	36%	.. .	..	35.7%	0.9%
8	11-4	36%	10-4	40%	11-4	36%	6-2	33%*	.. .	..	36.2%	0.7%
12	8-3	37%	.. .	..	.. .	..	.. .	..	9-3	33%	35.0%	
16	.. .	..	.. .	..	.. .	..	9-4	44%	8-3	37%	40.0%	
24	13-5	38%	6-3	50%	14-5	36%	8-4	50%	11-5	45%	43.8%	3.9%
36	7-3	43%	.. .	..	.. .	..	.. .	..			43.0%	
48	10-5	50%	6-3	50%	7-4	57%	11-5	45%	16-9	56%	51.6%	1.4%
72	6-3	50%	13-3	23%	8-4	50%	10-5	50%	10-6	60%	46.6%	4.8%

* Recall could not have been taken if presentation had been at the regular hour; presentation was given at eleven P. M.

E. O. Finkenbinder. Visual-vocalizer.

Times of presentation.

	8 A.M.		11 A.M.		2 P.M.		5 P.M.		8 P.M.		
Interval.	Presentations at learning; at relearning.	Forgotten.	Presentations at learning; at relearning.	Forgotten.	Presentations at learning; at relearning.	Forgotten.	Presentations at learning; at relearning.	Forgotten.	Presentations at learning; at relearning.	Forgotten.	Average percentage forgotten.
1/2	14-4	29%	13-3	23%	12-2	17%	11-3	27%	12-2	17%	22.3%
1	9-3	33%	10-3	30%	9-2	22%	12-4	33%	11-3	27%	28.1%
2	11-4	36%	11-2	18%	15-2	13%	12-4	33%	11-3	27%	24.8%
4	8-3	38%	15-5	33%	11-3	27%	12-5	42%	.. . ..		32.6%
8	12-6	50%	12-4	33%	11-4	36%	10-3	30%*	11-4	36%*	37.1%
12	10-4	40%	.. . ..		.. . ..		.. . ..		8-2	25%	32.5%
16	.. . ..		.. . ..		.. . ..		9-4	44%	13-4	31%	37.5%
24	9-4	44%	11-5	45%	10-4	40%	13-7	54%	9-4	44%	45.6%
36	12-5	42%	.. . ..		.. . ..		.. . ..		12-5	41%	41.6%
48	13-5	38%	9-5	55%	10-8	80%			11-5	45%	54.8%
72	10-6	60%	13-6	46%					9-5	55%	57.5%

* Presented at 11 P. M.

Alida C. Bowler. Visual-vocalizér.

Times of presentation.

	8 A.M.		11 A.M.		2 P.M.		5 P.M.		8 P.M.		
Interval.	Presentations at learning; at relearning.	Forgotten.	Presentations at learning; at relearning.	Forgotten.	Presentations at learning; at relearning.	Forgotten.	Presentations at learning; at relearning.	Forgotten.	Presentations at learning; at relearning.	Forgotten.	Average percentage forgotten.
1/2	8-1	13%	7-0		8-2	25%			7-1	14%	17.3%
1	7-1	14%	8-2	25%	8-3	37%					25.0%
2	6-1	16%	7-1	14%	7-2	28%			9-1	11%	17.7%
4	8-2	25%	10-1	10%	7-2	28%					21.3%
8	8-3	37%	8-2	25%			.. .	..	.. .	..	31.0%
12	6-4	66%	.. .	..	.. .	..	.. .	..	7-1	14%	40.0%
16	.. .	..	.. .	..	.. .	..			7-1	14%	14.0%
24	8-3	37%	6-1	17%	10-2	20%	13-3	23%	6-2	33%	26.2%
36	7-2	30%	.. .	..	.. .	..	.. .	..	7-1	14%	22.0%
48	8-5	62%	6-3	50%	8-5	62%			7-3	42%	54.0%
72	6-3	50%	9-5	55%	8-4	50%					52.0%

A. M. Overland. Visual-vocalizer.

Times of presentation.

	8 A.M.		11 A.M.		2 P.M.		5 P.M.		8 P.M.		
Interval.	Presentations at learning; at relearning.	Forgotten.	Presentations at learning; at relearning.	Forgotten.	Presentations at learning; at relearning.	Forgotten.	Presentations at learning; at relearning.	Forgotten.	Presentations at learning; at relearning.	Forgotten.	Average percentage forgotten.
1/2	10-1	10%	9-4	44%	8-1	13%					22.3%
1	7-1	14%	8-2	25%							19.5%
2	7-2	29%	12-1	8%	8-1	13%			10-1	10%	16.6%
4	13-3	23%									23.0%
8	11-3	27%	8-2	25%	11-2	18%	.. . ..		.. . ..		23.3%
12	8-3	38%	.. . ..		.. . ..		.. . ..		10-2	20%	28.7%
16	.. . ..		.. . ..		.. . ..						
24	7-3	43%	11-2	18%					11-3	27%	29.3%
36	9-3	33%	.. . ..		.. . ..		.. . ..		10-2	20%	27.5%
48	13-5	38%	10-3	30%							34.0%
72			12-4	33%							33.3%

O. L. Herndon. Articulator.

Times of presentation.

	8 A.M.		11 A.M.		2 P.M.		5 P.M.		8 P.M.		
Interval.	Presentations at learning; at relearning.	Forgotten.	Presentations at learning; at relearning.	Forgotten.	Presentations at learning; at relearning.	Forgotten.	Presentations at learning; at relearning.	Forgotten.	Presentations at learning; at relearning.	Forgotten.	Average percentage forgotten.
1/2	19-4	21%	14-3	21%					13-4	31%	24.3%
1	16-3	17%	9-3	33%	27-6	22%			24-5	21%	23.7%
2	13-4	31%	15-3	20%	8-2	25%			14-6	43%	29.6%
4	16-5	31%	24-6	25%	17-6	35%			.. .	..	34.4%
8	15-9	60%	14-5	35%	12-2	16%	.. .	..	.. .	..	37.0%
12	11-4	36%	.. .	..	.. .	..	.. .	..	19-3	16%	26.2%
16	.. .	..	.. .	..	.. .	..			18-3	17%	17.0%
24	15-7	47%	14-6	43%	23-7	30%	18-7	38%	11-4	36%	38.6%
36	16-7	44%	.. .	..	.. .	..	.. .	..	11-3	27%	35.4%
48	19-10	53%	12-4	33%	18-11	61%			13-3	23%	42.5%
72	17-5	29%	12-4	33%	23-10	43%					35.3%

H. F. Swits. Visual.

Times of presentation.

Interval.	8 A.M.		11 A.M.		2 P.M.		5 P.M.		8 P.M.		Average percentage forgotten.
	Presentations at learning; at relearning.	Forgotten.	Presentations at learning; at relearning.	Forgotten.	Presentations at learning; at relearning.	Forgotten.	Presentations at learning; at relearning.	Forgotten.	Presentations at learning; at relearning.	Forgotten.	
1/2	11-3	27%	16-3	17%	10-3	30%	14-4	29%	11-3	27%	26.4%
1	14-2	14%	18-6	33%	15-4	27%	10-3	30%	8-3	37%	28.2%
2	10-4	40%	13-4	30%	12-4	33%	10-3	30%	10-2	20%	29.2%
4	10-3	30%	11-4	36%	14-3	21%	13-3	23%	.. .	..	27.7%
8	12-4	33%	14-6	43%	10-3	30%	.. .	..	.. .	..	25.3%
12	10-4	40%	13-7	54%					12-7	58%	47.0%
16	.. .	..	.. .	..	.. .	..	16-4	25%	14-5	26%	25.5%
24	11-4	36%	10-4	40%	11-4	36%	15-7	46%			39.5%
36	9-4	44%	.. .	..	.. .	..	.. .	..	7-4	55%	49.5%
48	11-5	45%	10-5	50%	12-5	41%					45.3%
72	14-7	50%	9-5	55%	12-7	59%	12-7	59%			55.9%

C. E. Burgener. Visual-slow-vocalizer.

Time of presentation.

	8 A.M.		11 A.M.		2 P.M.		5 P.M.		8 P.M.		
Interval.	Presentations at learning; at relearning.	Forgotten.	Presentations at learning; at relearning.	Forgotten.	Presentations at learning; at relearning.	Forgotten.	Presentations at learning; at relearning.	Forgotten.	Presentations at learning; at relearning.	Forgotten.	Average percentage forgotten.
1/2			9-3	33%	21-4	20%	12-5	46%	12-2	16%	34.0%
1	10-1	10%	6-3 11-3	50% 27%	15-4	27%	18-3	17%	13-3	23%	25.6%
2	15-3	20%	11-4	36%	14-5	35%			10-2	20%	28.0%
4	13-2	16%	7-3	43%	15-3	20%			.. .	..	26.3%
8	12-1	8%	14-6	43%	13-4	30%	.. .	..	.. .	..	27.0%
12			.. .	..	.. .	..	.. .	..	12-4	33%	33.3%
16	.. .	..	.. .	..	.. .	..	10-1	10%	15-9	60%	35.0%
24			12-4	33%	12-7	58%	8-4	50%			40.3%
36			.. .	..	.. .	..	.. .	..			
48							17-6	35%			35.3%
72			14-8	57%	11-6	55%	12-6	50%			54.0%

L. Seyster. Visual-vocalizer. (Rapid.)

Time of presentation.

	8 A.M.		11 A.M.		2 P.M.		5 P.M.		8 P.M.		
Interval.	Presentations at learning; at relearning.	Forgotten.	Presentations at learning; at relearning.	Forgotten.	Presentations at learning; at relearning.	Forgotten.	Presentations at learning; at relearning.	Forgotten.	Presentations at learning; at relearning.	Forgotten.	Average percentage forgotten.
1/2							10-3	30%	16-3	18%	24.0%
1							10-6	60%	9-3	33%	46.5%
2									8-4	50%	50.0%
4	10-4	40%							.. .	..	40.0%
8	13-4	30%					.. .	..	.. .	..	30.0%
12			.. .	..	.. .	..	.. .	..			
16	.. .	..	.. .	..	.. .	..			12-4	33%	33.3%
24									13-5 16-9	37% 56%	46.5%
36			.. .	..	.. .	..	.. .	..	9-2	22%	22.0%
48							12-6	50%			50.0%
72									12-9	75%	75.0%

J. Sinclair. Visual-auditory.

Time of presentation.

	8 A.M.		11 A.M.		2 P.M.		5 P.M.		8 P.M.		
Interval.	Presentations at learning; at relearning.	Forgotten.	Presentations at learning; at relearning.	Forgotten.	Presentations at learning; at relearning.	Forgotten.	Presentations at learning; at relearning.	Forgotten.	Presentations at learning; at relearning.	Forgotten.	Average percentage forgotten.
1/2	13-6	46%	12-4	33%					12-5	43%	43.7%
1			13-4	30%	14-5	36%					33.0%
2			9-3	33%			11-8	73%	13-8	62%	56.0%
4			10-3	30%			11-8	73%			61.3%
8			14-6 16-7	43% 45%			.. . ..		.. . ..		44.0%
12			.. . ..		.. . ..		.. . ..				
16	.. . ..		.. . ..		.. . ..				15-6	40%	40.0%
24			13-5	55%			12-5	42%			48.5%
36	13-6	46%	.. . ..		.. . ..		.. . ..				46.0%
48			12-6	50%							50.0%
72			13-7	56%							56.0%

Sara C. Fisher. Associative-auditory.

Times of presentation.

	8 A.M.		11 A.M.		2 P.M.		5 P.M.		8 P.M.		
Interval.	Presentations at learning; at relearning.	Forgotten.	Presentations at learning; at relearning.	Forgotten.	Presentations at learning; at relearning.	Forgotten.	Presentations at learning; at relearning.	Forgotten.	Presentations at learning; at relearning.	Forgotten.	Average percentage forgotten.
1/2	14-1	7%	8-1	13%	15-2	13%			8-1	13%	11.3%
1	14-1	7%	9-2	22%	25-1	4%			13-2	15%	12.1%
2	11-2	18%	12-1	8%	17-2	12%			8-1	13%	12.6%
4	8-1	13%	20-1	5%	11-1	9%			.. .	..	8.8%
8	7-1	14%	9-1	11%	6-2	33%	.. .	..	.. .	..	19.5%
12	13-4	31%	.. .	..	.. .	..	.. .	..	8-2	25%	27.8%
16	.. .	..	.. .	..	.. .	..			12-4	33%	33.3%
24			10-1	10%	16-5	31%			7-1	14%	18.4%
36	9-2	22%	.. .	..	.. .	..	.. .	..	11-2	17%	22.2%
48			8-2	25%	13-3	23%			9-3	33%	27.1%
72	7-4	55%	6-3	50%	13-3	23%			8-3	37%	42.4%

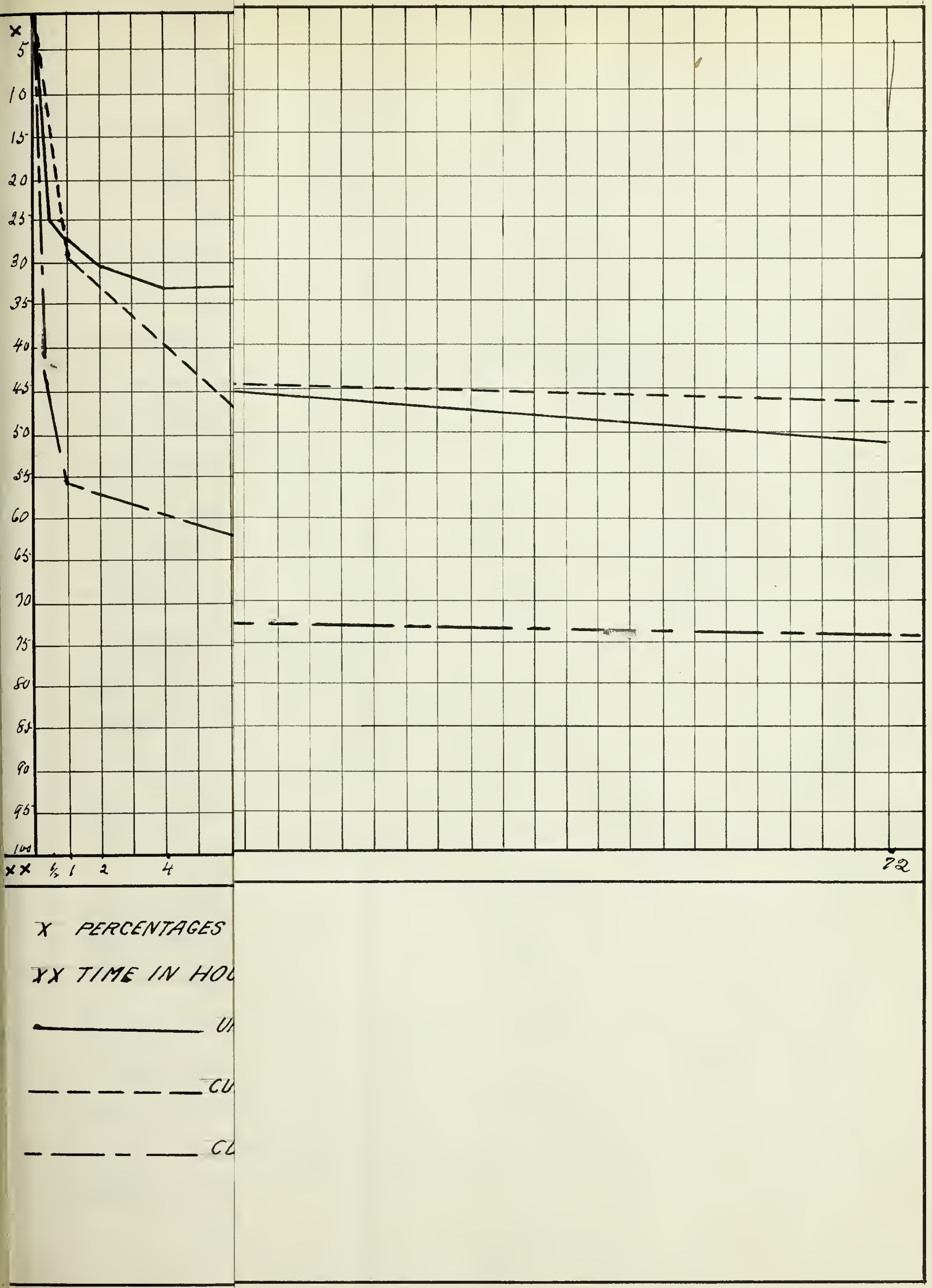
Comparison of Results Arrived at from the Use of Meaningless Materials.

Interval.	Ebbinghaus.	Radossawljewitsch.	Univ. of Illinois.
	Percentages forgotten.		
20 Min.	41.8%	11.4%	....
30 "	....	....	25.0%
1 Hr.	55.8%	29.3%	27.2%
2 "	....	....	30.6%
4 "	....	....	33.6%
8 "	64.2%	52.6%	33.3%
12 "	....	....	34.9%
16 "	....	....	40.5%
24 "	66.3%	31.1%	42.2%
36 "	....	....	41.2%
48 "	72.2%	39.1%	44.5%
72 "	....	....	51.9%

After reading the above table it is fitting to examine again the interpretation of the results of previous investigations. The curve found in this investigation shows a greater percent retained than the Ebbinghaus curve but greater percent forgotten than the curve of Radossawljewitsch. The curve is an even one as is that of Ebbinghaus and does not show the sag at the eight-hour point as does the curve of Radossawljewitsch. The percentage forgotten by Ebbinghaus himself as observer, was not substantiated by the observers of Radossawljewitsch. The latter investigator did not eliminate a fixed order in learning but the former did so. No observer under the methods employed by Radossawljewitsch and by the experimenters at the University of Illinois has shown so great an amount of forgetting as did Ebbinghaus. It would appear that even if more observers had worked in the experiment with Ebbinghaus his results would have been about the same. The fact that he was observer and experimenter at the same time, is unfavorable to the best results, but the elimination of sequence in learning the syllables is very likely an important fact in the high percentage which we obtained.

Ebbinghaus was careful to distribute the learning times throughout the day for each observer. Thus he chose the hours 10-11 A. M., 11-12 A. M., 1-3 P. M., and 6-8 P. M. Radossawljewitsch however used the same period for learning, always at 1-2 P. M. His recall after eight hours thus came at 9-10 P. M. when his mental and physical condition was perhaps less favorable than at 1-2 P. M. Each observer also had one time for learning - e.g., "1. Lu" at 7-8 A. M. and thus his eight hour recall fell at about four P. M., probably a time of low mental activity; "2. R" at 8-9 A. M.; and "7. J" at 9-10 A. M. gave the best record of learning but their recall

and relearning fell in the latter part of the day after the eight-hour interval when the mental grasp was low. Clearly if observations had been made at all times of the day for each observer, the influence of fatigue would have been controlled. This has been attempted by the author in the following way. Each observer learned his series at 8 A. M., 11 A. M., 2 P. M., 5 P. M., 8 P. M., and for the particular eight hour interval at 10-11 P. M. and at 6 A. M. - relearning in the morning and at 2 P. M. when many learn most quickly thus minimizing the influence of fatigue by distributions of the periods of learning and recall throughout the day. Another weakness in Radossawljewitsch's method is noted in that he made but one determination for each observer for any point in the curve. Another step gained by the University of Illinois experiments is that while the former investigators tried only twenty-minute, one-hour, and eight-hour intervals, this experiment has included two-hour and four-hour intervals and also the other comparatively short intervals. The curve herein traced falls between the curve of Ebbinghaus and that of Radossawljewitsch. The experimenters conclude that by the method of computing the probable error a trust-worthy curve is discovered. The curve shows less forgetting than the Ebbinghaus curve, this being partly due to the elimination of fixed order of the syllables in his experiment. The sag at the eight-hour interval in Radossawljewitsch's curve is probably due to the fatigue element and is not found in the curve determined at the University of Illinois. The results of Ebbinghaus, Radossawljewitsch, and the investigators of the University of Illinois are tabulated below.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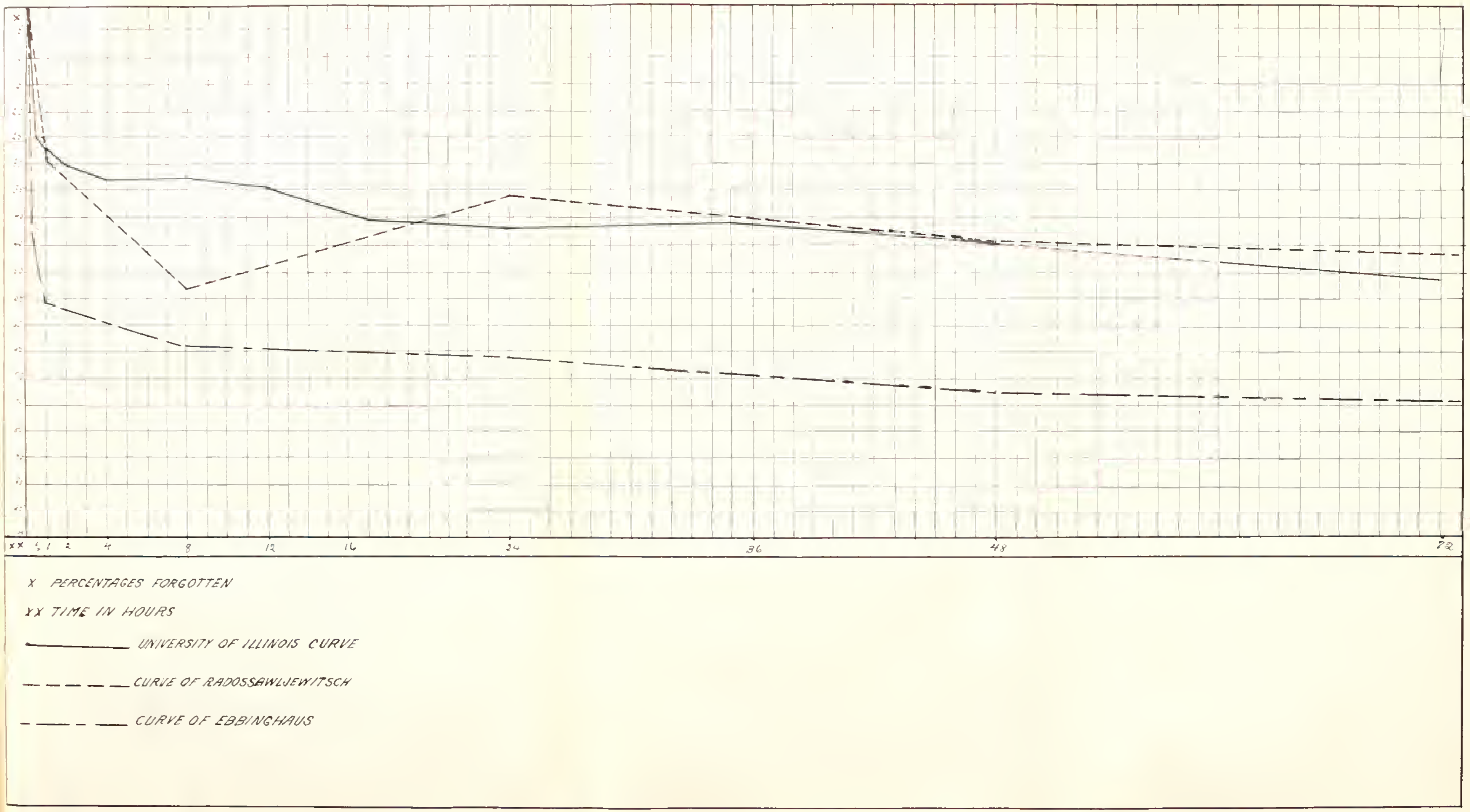
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X PERCENTAGES FORGOTTEN
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UNIVERSITY OF ILLINOIS CURVE
CURVE OF RADOSSAWLJEWITSCH
CURVE OF EBBINGHAUS

Facts relative to the main object of investigation, but not essential to the explanation of the curve of forgetting, have been obtained:

1. Nonsense syllables prove meaningless for the most part, but not entirely.

2. Where meaning is aroused in learning, the methods here used for determining the quantity forgotten are not sufficiently precise to reveal the fact in the numerical results. Only where a third or a half of the syllables aroused meaning cound that fact be detected in the numerical result.

3. The amount of the recall just previous to the relearning was found to be so variable that little significance could be placed in it. Radossawljewitsch gave undue emphasis to the absolute [*] savings it seems, for the observer has proved by long thinking and by the best of attention that the "absolute saving" is not absolute but varies greatly with the mental disposition of the learner. Recall in the University of Illinois experiment was only just what the observer had in mind and could easily write down.

4. The visualizer appears most accurate in recall.

5. The observer with most associations forget just a little less than did Radossawljewitsch's observers.

6. The purely nonsense learners, mostly visualizing but also vocalizing in learning, forgot least, except Miss Fisher above mentioned. They are Alida C. Bowler, ~~Sarah~~ Sophie Rogers, E. B. Pletcher, and J. E. Wiley. They have saved about 3% more than the average of all observers. Mr. Swits, visualizer, retained about the same amount as the average of all.

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[*] By absolute savings Radossawljewitsch means the number of syllables reproduced correctly after the desired interval.

	Average of all	S. C. F. associative auditory.	S. R. visual vocalizer.	J. E. W. visualizer.	E. B. P. visualizer.
1/2	25.0%	11.3%	20.2%	23.2%	21.8%
1	27.2%	12.1%	27.0%	24.6%	31.0%
2	30.6%	12.6%	29.8%	29.2%	31.0%
4	33.6%	8.8%	38.0%	25.2%	35.7%
8	33.3%	19.5%	40.0%	35.3%	36.2%
12	34.9%	27.8%	40.0%	27.3%	35.0%
16	40.5%	33.3%	39.0%	42.1%	40.0%
24	42.2%	18.4%	42.4%	45.8%	43.8%
36	41.2%	22.2%	50.0%	38.0%	43.0%
48	44.5%	27.1%	50.0%	46.0%	51.6%
72	51.9%	42.8%	52.8%	49.1%	45.7%

7. Learning was most rapidly done by three observers at 2 P. M. and by three at 8 P. M. - two observers learned most easily at both 8 A. M. and 8 P. M. as may be seen from the results given below.

Average time, in seconds, taken for learning.

Observer.	8 A.M.	11 A.M.	2 P.M.	5 P.M.	8 P.M.
J. E. W.	197	197	161	229	259
A. C. B.	173	182	192	312	170
E. B. P.	228	222	220	227	252
S. R.	236	233	228	225	229
L. J. P.	280	259	234	295	252
R. R. F.	264	266	244	278	242
E. O. F.	259	281	266	271	258
O. L. H.	301	341	437	432	367

8. Those who learned most easily retained the most, no matter by what type of imagery used.

Percentage forgotten.

Intervals in hours.	A. C. B.	L. J. P.	J. E. W.	E. O. F.
1/2	17.3%	26.0%	23.2%	22.3%
1	25.0%	33.7%	24.6%	29.2%
2	17.7%	34.4%	29.2%	24.8%
4	21.3%	40.2%	25.2%	32.6%
8	31.0%	38.2%	35.3%	37.1%
12	40.0%	39.5%	27.3%	32.5%
16		39.0%	42.5%	37.5%
24	26.2%	42.6%	46.0%	45.6%
36	22.0%	46.3%	58.0%	41.6%
48	54.5%	51.8%	46.0%	54.8%
72	52.0%	66.6%	49.0%	57.7%

Miss A. C. B., visual-vocalizer, average time in learning - 206 seconds.

L. J. P., visual-slow-vocalizer - 264 seconds.

J. E. W., visualizer - 208 seconds.

E. O. F., visual-auditory-vocalizer - 267 seconds.

In conclusion, the writer firmly believes that the investigation has proved that the great variation at the eight hour interval found by Radossawljewitsch was due to greater fatigue of his observers at the time of recall and relearning, and that the curve of forgetting does not have a sag at the end of eight hours but that the curve is uniformly regressive (Prof. Henry L. Rietz, stat-

istician, holds this opinion after reviewing the results of the experiment.) The methods of this experiment for determination of the quantity forgotten have not been sufficiently precise to reckon to a fraction of one per cent nor even to a single per cent. Yet an average of the variations due to different states of the observer and to differences in the material presented has determined the true curve of forgetting. The curve of any fourteen observers can only approximate the average for the individual. The various curves found seem of relative importance to the average curve. Though more data are still being gathered by the experimenter, yet the investigation to date has yielded to the satisfaction of the experimenters that there is an even curve of quantitative forgetting.

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